

S O U T H E R N R A I L W A Y

A S H F O R D

ENGINE DRIVERS & FIREMENS MUTUAL IMPROVEMENT CLASS.

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M O D E L

Q U E S T I O N S & A N S W E R S

arranged by

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Ashford (Kent) Loco.

## E N G I N E

(Q.) Trace steam from boiler to chimney (saturated) regulator valve in dome.

(A.) Steam passes via regulator valve in dome through the internal steam pipe to the external steam pipe to the steam chest where it is distributed to the cylinders by the slide valves where it does its work after which, it comes out the same way as it went in and is liberated to the atmosphere by the cavity of the slide valve and blast pipe.

(Q.) Trace steam on a superheated, regulator in dome.

(A.) Steam passes via the regulator valve to the internal steam pipe to the saturated side of the header (where it puts the drifting valves on their seats) through the element tubes to the superheated side of the header, to the external steam pipes then to the piston valves which distribute the steam to the cylinders. After doing its work it passes out of the cylinders the same way as it went in and is liberated to the atmosphere on the exhaust side of the piston valve head, exhaust channels and blast pipe.

## P I S T O N V A L V E

(Q.) Name the parts of the piston valve.

(A.) Cotter pin, castle nut, valve body, schmitz ring, diaphragm plate, distance piece, diaphragm plate, schmitz ring, valve body, adjusting washer, valve sleeve and valve spindle. (Fig.1)

(Q.) What are the general benefits of the piston valve?

(A.) Frictional losses greatly eliminated, cost of upkeep low (some engines may require a new pair of slide valves in 3 months while the piston valve under similar conditions would go 3 years) quick exhaust release and back pressure greatly eliminated.

(Q.) What is most important on superheaters fitted with piston or slide valve?

(A.) Lubrication, owing to the hard dry scouring nature of superheated steam. Correct and close attention must be paid to the lubricator, too much can be just as harmful as too little.

(Q.) What method of lubrication is used?

(A.) Either the sight feed Hydro static or the mechanical is general.

(Q.) Explain the working of the Hydro static and what does the name imply?

(A.) Hydro - water, static - balance, water balance lubricator. Turn on boiler steam, part of which goes to the condenser outside cab from which cool water runs to the bottom of lubricator, oil being lighter than water flows to the top of the lubricator down a centre pipe where it is met by a regulator this being opened, oil passes along a channel to the sight regulator up through the water in the sighting chambers to the top of lubricator, where it is met by live steam and carried along to the valves and pistons; just before it reaches these it has to pass through a choke or emulsification nipple thus making the oil foamy or atomized - the correct method of applying oil.

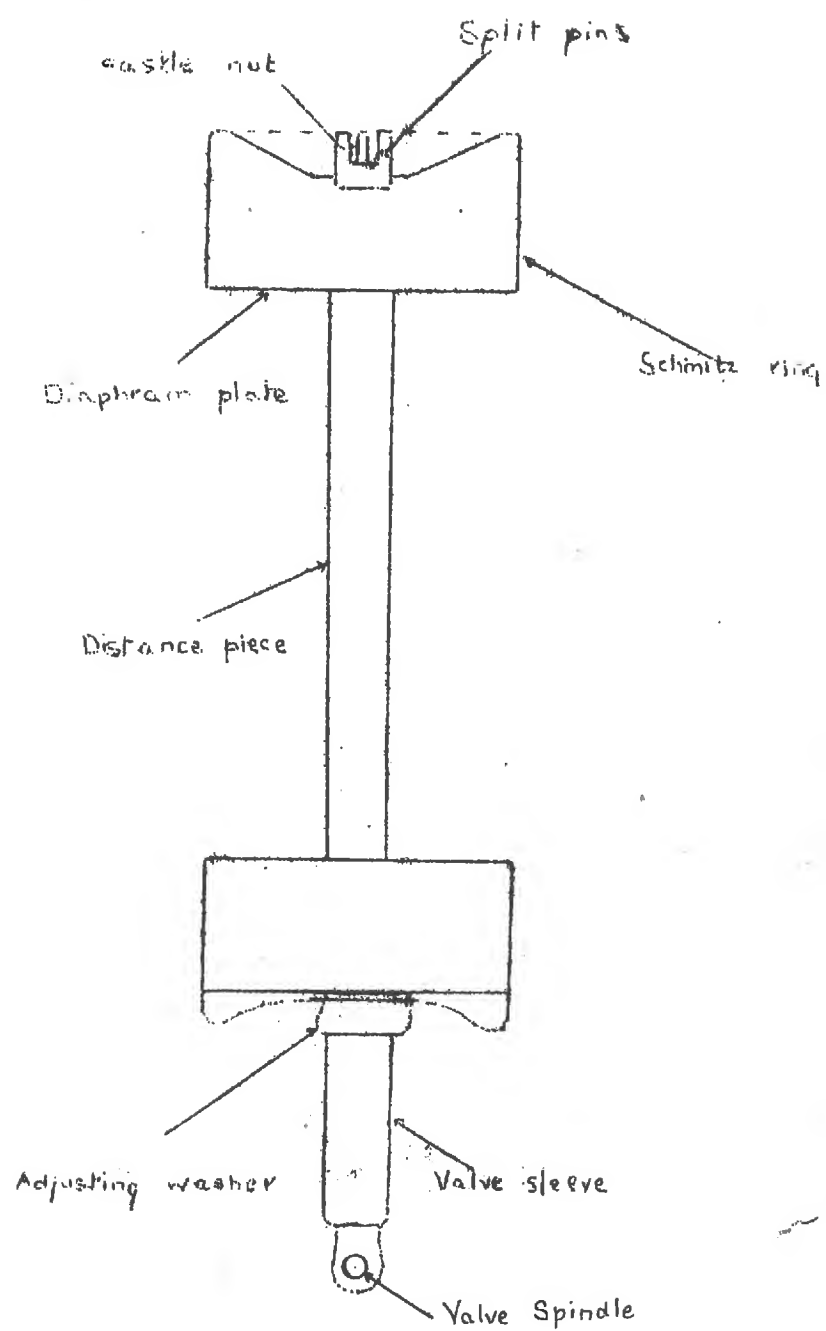


Fig. 1

(Q.) Set the engine to test valves and pistons.

(A.) Place large end on top centre, lever foreway - testing all behind piston. Lever backway - testing all in front of piston. Lever in middle - testing valve. The other side engine being given lead steam.

(Q.) What is lap?

(A.) Lap is the amount the valve over covers the live steam port when the valve is placed in the mid position.

(Q.) What exactly is steam?

(A.) The elastic vapour from water when heated to 212 degrees Fahrenheit (boiling point.)

(Q.) What is the use of the brick arch?

(A.) More perfect combustion by diverting the flames and gases to the back of firebox, also to keep the temperature of the firebox more equal.

(Q.) What is the use of the deflector plate?

(A.) This plate directs the cool air downwards and prevents same from going direct to the tubes.

(Q.) What are the chief causes of an engine steaming badly?

(A.) Bad coal, mismanagement of the fire, dirty tubes, smoke box drawing air, joints blowing in smoke box and blast pipe out of line with chimney.

(Q.) What is lead steam?

(A.) Lead steam is the amount of steam admitted to the cylinder before the piston reaches the end of its stroke thus forming a cushioning effect.

(Q.) How does the injector work?

(A.) All injectors work on the same principle viz: Velocity (speed) Momentum (movement) and Vacuum. Ordinary automatic Turn on feed water - this floods the injector, turn on live steam, the velocity of which is conveyed to the momentum of the water. The rapid condensation that now takes place causes the necessary vacuum to lift the combining cone across to the delivery pipe and boiler.

(Q.) How does the exhaust injector work?

(A.) The same principle applies. Exhaust steam, plus supplementary steam gives the necessary velocity to the momentum of the water, (the exhaust steam when allowed to enter a vacuum - a vacuum tube is fitted in exhaust injectors - will issue at the other end at 2,000 (two thousand) feet per second.) The two jets of steam coming into contact with the water causes the rapid condensation - and of course, vacuum, and from there the same as the previous answer.

(Q.) If your reverser would not hold up how can you tell it is the water valve or the leathers?

(A.) Place lever in the centre, disconnect water valve, now put way valve forward and give steam, now back-way and give steam. - Deduction: If lever will move both ways, its the water valve; if only one way, its the leathers (Fig.2)

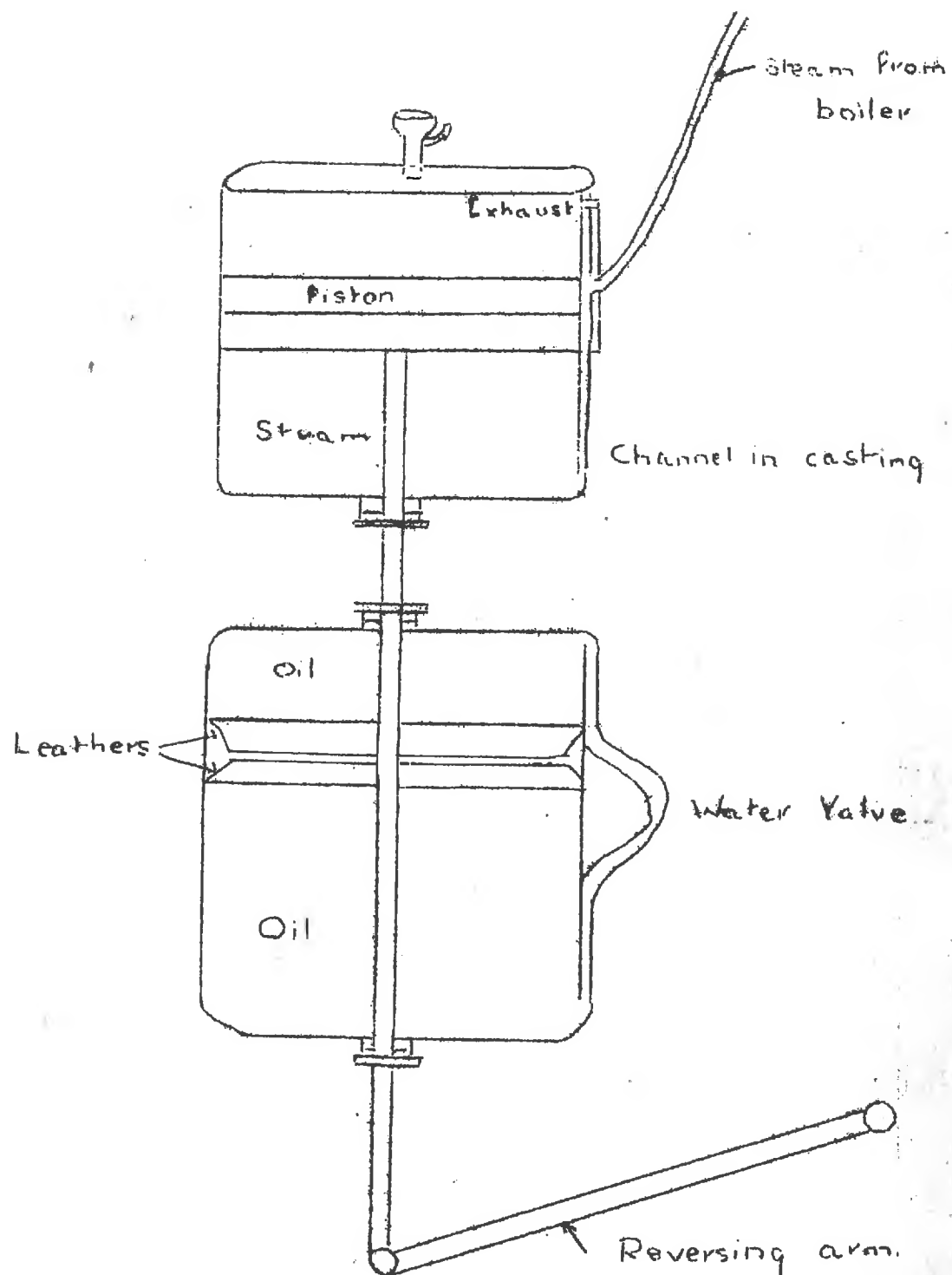


Fig 2

(Q.) How do you prepare the bars and generate steam without making a smoke?

(A.) Push fire over box and put in about two buckets of beach in and around the centre of the box, and to fire without making a smoke, well damped coal, fire lightly and keep the fire hole door open.

(Q.) What constitutes good coal for locomotives?

(A.) Say 100 parts: Carbon 85, Hydrogen 5, Nitrogen 7, Sulphur 1, and Ash 2.

(Q.) What is very important especially when preparing a superheater?

(A.) To see the smoke tubes and steam tubes are cleaned off.

(Q.) How does the blower work?

(A.) An internal steam pipe runs from the dome to blower valve, from there through the boiler to the top of blast pipe.

(Q.) Explain how the steam sand works.

(A.) An internal steam pipe runs from dome to steam sand valve on foot plate. Steam is now sent down the external steam pipe to sand pipe nozzle, the velocity of this steam rushing out to the atmosphere causes a vacuum to be formed or created in the sand pipe, air rushes in at the trap (to destroy the vacuum thus formed) in doing so carries with it the sand in trap and so to the rail. (Fig. 3)

(Q.) How do you create a brake and what takes place?

(A.) Open small jet on the ejector, steam now rushes round the cone at high velocity (through the cone on Davies & Metcalf) inducing air to follow it from all parts of the brake, the brake pistons falling by their own weight to the bottom of the cylinders, with only the small jet working, the small ejector back stop valve is off its seat; when the larger ejector is being used, both back stop valves are off their seats.

To apply brake. Place the handle in the 'on' position, air rushes in to the train pipe via the drivers brake handle down the train pipe to the bottom side of brake pistons. (Air is prevented from going to the top of piston by the ball valve placed at the bottom) Correct adjustment of brake, piston should travel just over half way.

(Q.) What would you do if your brake (a) seized on (b) off?

(A.) (a) If my brake seized on, knock out the pin at bottom of piston rod, use the hand brake and proceed cautiously until I could get another engine.

(b) Use hand brake and proceed cautiously until I could get another engine.

(Q.) How does the steam brake work?

(A.) Steam at boiler pressure is passed via the steam brake valve to the external steam pipe, thence to the brake cylinder where it pushes the piston downwards (compressing a coil spring for release purposes) thus exerting its pressure on the brake rigging. The brake piston head is made up of a loose head, two mitred-shaped piston rings and the head body, four holes are drilled down through the lot and bolts are used to keep the entire complete head in position. To release the brake, place the brake valves in the off position, the exhaust port on the brake attachment is now opened, allowing the steam to pass back from the cylinder to the external steam pipe.

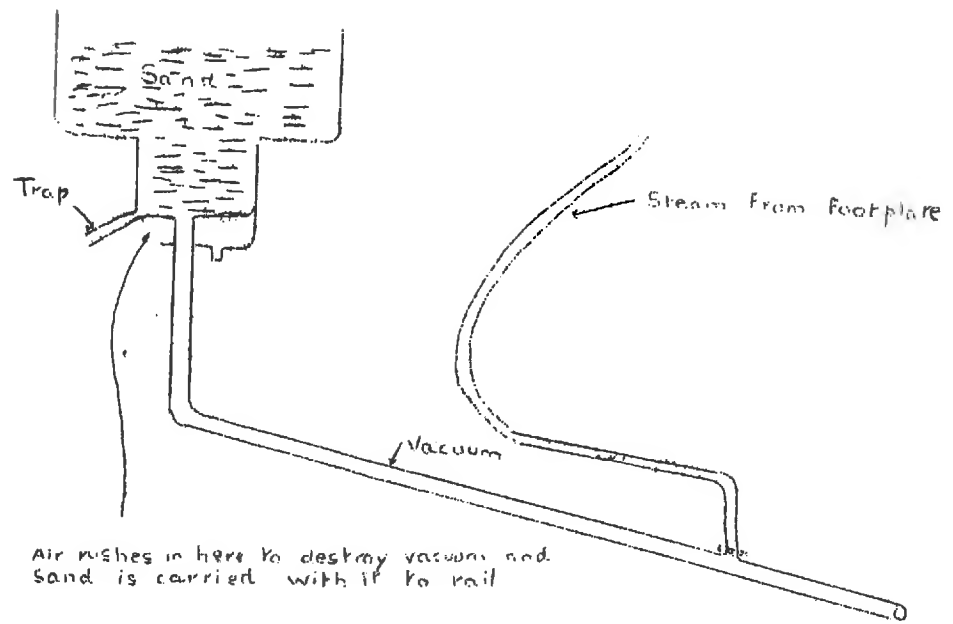


Fig 3

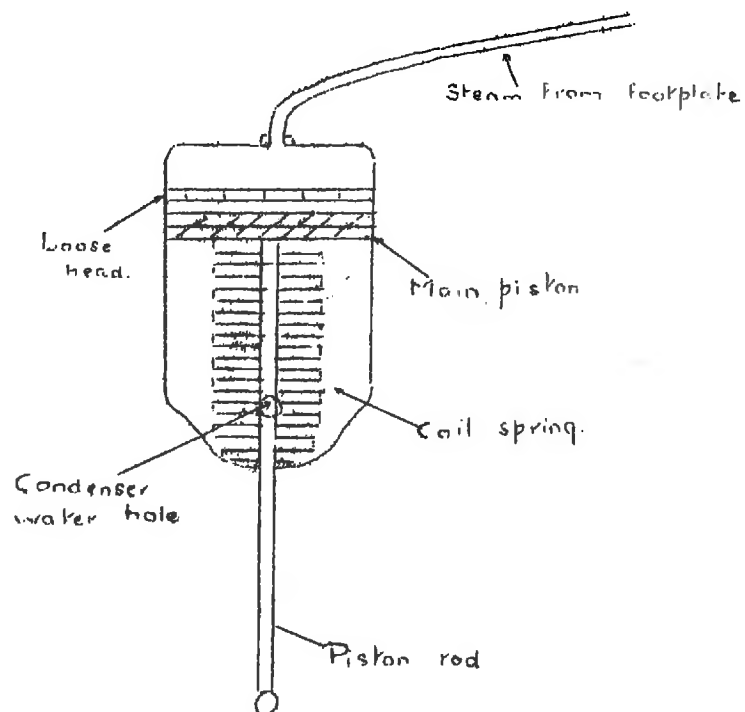


Fig 4

exhaust port brake barrel and chimney. The steam with no pressure condenses and trickles down between the loose piston head and mitred rings through a hole in the main piston head to the bottom of the cylinder, where it is ejected when the brake is next applied. Care should be taken to see that the condensed water hole is always clear, otherwise water would fill up to the bottom of piston and brake would become inoperative when applied. (Fig.4)

(Q.) How does the clutch work?

(A.) The clutch piston (Model 1.) is exactly like the steam brake piston in miniature, i.e. loose head, two rings and main head. (Model 2.) Just an ordinary piston with packing nut at bottom of cylinder. Open clutch valve on foot-plate - this sends steam along the external steam pipe to clutch cylinder, pushes piston down, this exerts pressure on clutch drum and grips way bar shaft. To release, place handle in release position, exhaust port is opened to atmosphere and the steam returns back to the footplate to the clutch valve and so released.

(Q.) What are the four distinct events which take place during each piston stroke?

(A.) Admission, expansion, exhaust, and compression.

(Q.) What is piston clearance?

(A.) The space between the piston and cylinder cover at each end of the stroke (about  $3/16$  in.)

(Q.) How many dead centres are there?

(A.) Two for each engine back and front.

(Q.) Follow the beats of left lead engine starting from left back. (fore-way)

(A.) Left back; right back; left front; right front.

(Q.) Three cylinder. (fore-way)

(A.) Right front (1); middle back (2); left front (3); right back (4); middle front (5); left back (6). (Fig. 5a)

(Q.) The Lord Nelson. (fore-way)

(A.) The number to remember is:

LOF 3 . 6 . 4 . 1 ROF

LOB 7 . 2 . 8 . 5 Right outside back or

Right outside front	1
Left inside back	2
Left outside front	3
Right inside front	4
Right outside back	5
Left inside front	6
Left outside back	7
Right inside back	8

This is starting from right outside front. (Fig. 5b)

(Q.) Name the parts of (a) Large end, (b) Eccentric, (c) Small end.

(A.) (a) Large end strap, top, syphon pipe trimming, large end bolts, key, set bolts, brasses.

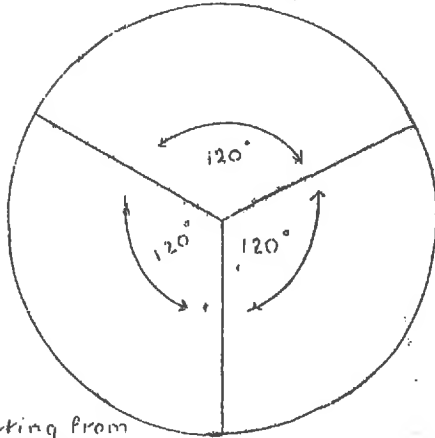
(b) Eccentric sheave, liner, distance pieces (top and bottom) eccentric strap, top and trimming and syphon pipe, top strap bolt, bottom strap bolt, top rod stud and bottom rod stud.

(c) Small end strap, brasses, bolts key, set bolts, top, syphon pipe and trimming.



### 3 CYLINDER

Each engine is 120° apart.



Starting from  
Right front

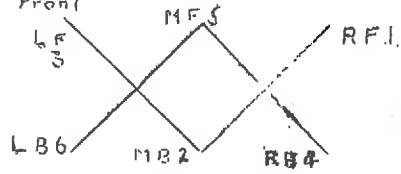


FIG 5 (A)

### LOAD NELSON (4 CYLINDER)

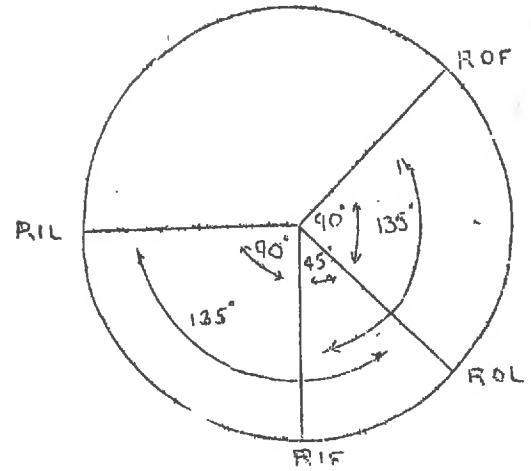
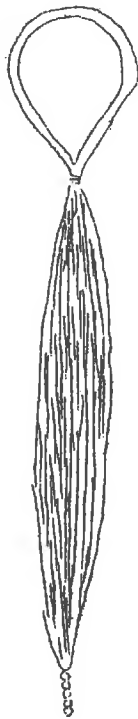
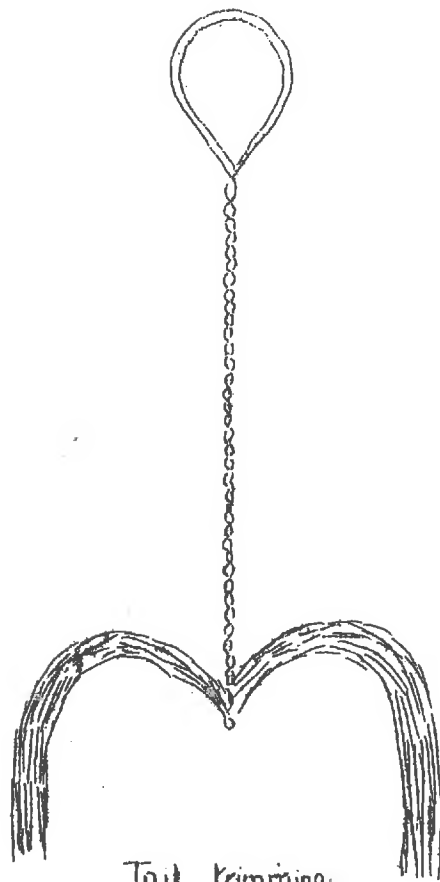


FIG 5 (B)



Plug Krimming



Tail Krimming

FIG 6.

(Q.) Some engines have 3 sets of links: what are their names?

(A.) Suspension links, lifting links and quadrant or expansion links.

(Q.) If your regulator became uncoupled with steam on, what would you do?

(A.) Carry on until I could get assistance: if I wanted to shut off steam, I should put the engine in mid gear and open (if necessary) the cylinder cocks, and to start train, let the lever over very carefully.

(Q.) If both injectors failed, what would you do?

(A.) Get to the next station if possible, if not, either throw out fire or damp down with ballast and send for assistance.

(Q.) What is (a) a plug trimming and where is it used and (b) a tail trimming and where is it used?

(A.) (a) A plug trimming is built up and down the wire used in its construction and has no loose pieces over the syphon pipe and is used in large and small ends, eccentrics, side-rods, etc. (Fig. 6)

(b) A tail trimming is so constructed so as to lie in the bottom of a box or motion cup or anywhere where there is no 'throw' and is fitted to boxes, motion cups, gland cup, etc. (Fig. 6)

(Q.) Why are canes used or why the piece of cane in the cork?

(A.) To allow the oil to syphon, otherwise an airlock would occur and no oil would be used.

(Q.) How is an eccentric placed on the shaft?

(A.) A quarter of a turn plus lap and lead.

(Q.) What is the rocking shaft for on a Stephenson link motion fitted with piston valves (inside admission.)?

(A.) To form an adverse movement to the valve: when the eccentric is forward, the valve back etc.

(Q.) How does the steam gauge work?

(A.) Water in the gauge pipe exerts its pressure on a curved hollow spring inside the gauge, the boiler pressure tending to straighten, or otherwise this spring operates small geared wheels one of which is attached to the steam gauge hand.

(Q.) What is the danger of running with too much water in the boiler?

(A.) Priming, with a possible danger of knocking out a cylinder head, also washing all the oil off the cylinder walls (etc.)

(Q.) What is expansion?

(A.) The point between out-off and release.

(Q.) What is exhaust point?

(A.) The point the slide valve or piston valve uncovers or opens the exhaust port.

(Q.) What is compression?

(A.) Compression is the period during which the piston travels in the cylinder after the exhaust is closed.

(Q.) How do you tell if an eccentric has shifted?

(A.) Uneven beats and symptoms would be seen on shaft.

(Q.) How do you tell which is the foreway and backway rods?

(A.) Place the lever foreway and the eccentric rods that come into line with the valve will be the foreway rods.

(Q.) How do you tell if the die block and bolt have seized?

(A.) First, the pins would indicate this, as when seized they are sheared off, and I should carry on until I got to my depot, give extra lubrication and report same at shed.

(Q.) When is it dangerous to apply the sand when engine is slipping?

(A.) It is dangerous to apply sand when the engine is actually slipping, as the sudden stopping of the wheels by the grit applied may cause the siderod or rods to bend. Always wait until the wheels have stopped slipping before applying sand.

(Q.) How do you try the wedges?

(A.) Set the engine to take the weight away from wedge and leave brake off.

(Q.) What is meant by box knock?

(A.) The box bearing has become worn, consequently the shaft journal is a bad fit and when the engine takes steam at either end of the cylinder, the journal is driven to the other side of the box bearing with the accompanying 'knock' that we hear.

(Q.) How can you tell the difference between a box knock and a big end knock?

(A.) Set the engine say with the large end on top centre, put lever foreway and give steam, then backway and give steam. If it is the large end it will readily be seen by the journal moving in the brasses, or if a box knock, by the amount of movement in bearing and box.

(Q.) Explain briefly the working of the Westinghouse and Stroudley Westinghouse.

(A.) Turn on boiler steam to the donkey - this pumps air with a double action to the main reservoir up to 90 lbs. (a **governor** regulates this) The air from here is allowed to pass to the auxillary reservoir up to 70 lbs. of air; this is also connected to the drivers brake valve. To apply brake, the driver moves his brake valve to the 'on' position and releases a small amount of air to the atmosphere. The air has been released from the bottom side of the triple valve, which now drops, putting the auxillary reservoir into communication with the bottom side (on a Stroudley) of the brake piston. With a Westinghouse, the air is admitted to the top of the cylinder. To release brake, place the handle in release position. This again restores the triple valve to its release position, thus allowing the 90 lbs. of air in the main reservoir to overcome and release quickly the 70 lbs. of air with which the brake was applied. Attention should be given to the Stroudley type brake cylinder, as air is admitted to the bottom of the cylinder and the leather washer around the piston rod hole in cylinder does become hard and is liable to allow the air pressure to leak away with a consequent unreliable brake application. (Fig. 7)

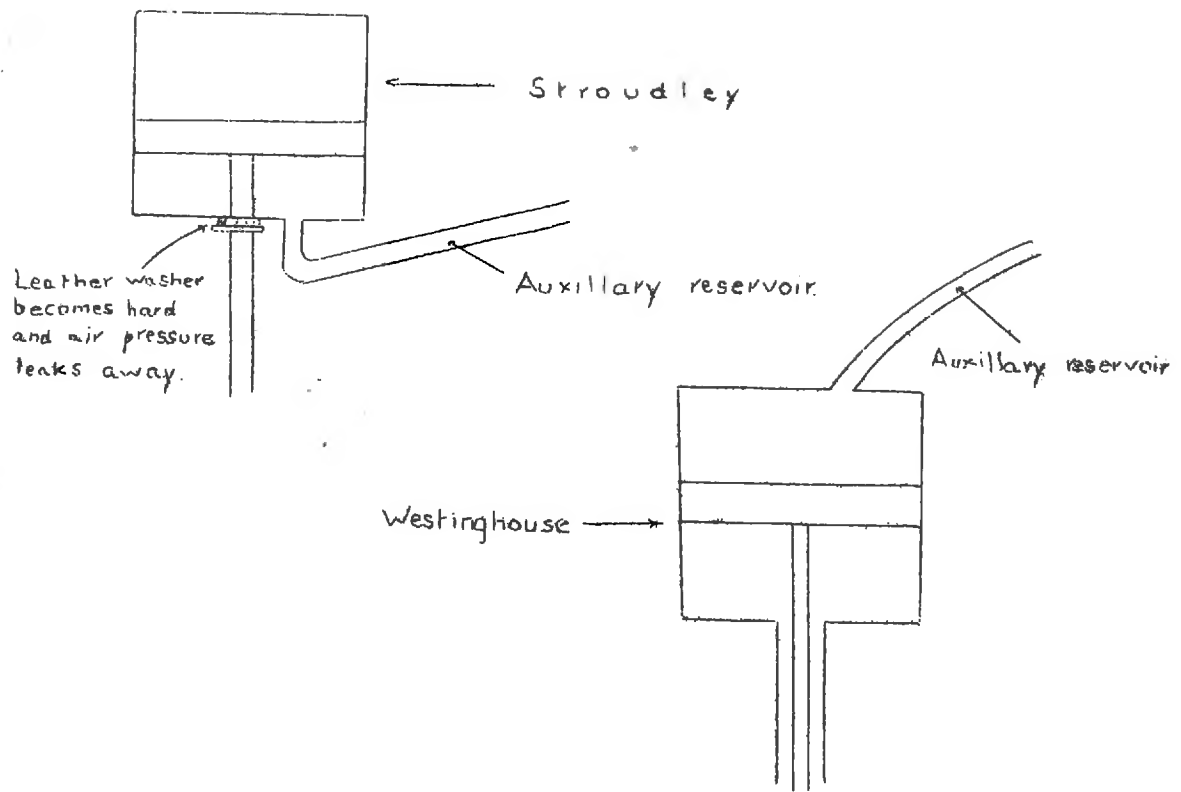
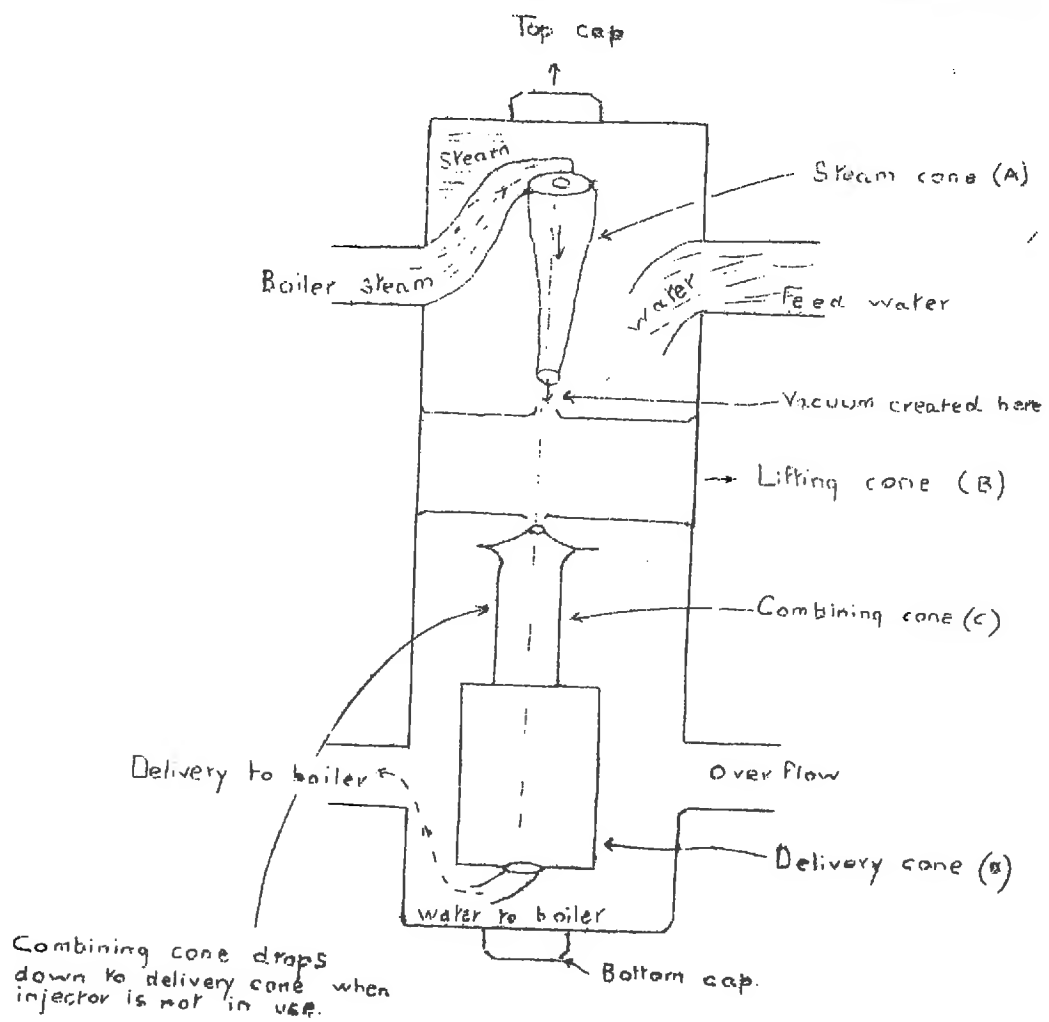


Fig 7



Drawing shows injector working and combining cone lifted

Fig 8

(Q.) Name the principal parts of the Walschaerts gear.

(A.) Eccentric crank, Eccentric rod, Connecting rod, Crosshead, Crosshead connecting link, Combination lever, Radius rod, Reversing rods, Links, Quadrant block. (Fig. 9)

(Q.) Where is the weight on bars when going foreway?

(A.) Weight on top bars foreway and bottom backway.

(Q.) How do you tell which are the back and foreway eccentric rods?

(A.) Place lever foreway and the eccentric rods that come in line with the valve will be the foreway rods.

(Q.) What do the numbers on the notch plate represent, and give an illustration?

(A.) Lever on the  $50^{\circ}$ , this means that the main piston is receiving live steam for 50 per cent of its stroke; or lever on  $25^{\circ}$  means that the piston is getting live steam for 25 per cent, or a quarter of its stroke. (Fig. 10)

(Q.) How does the Vacuum Pump work?

(A.) The piston in the pump is double acting; on each stroke it is capable of creating a higher degree of vacuum than is in the train pipe, consequently, on each stroke it ejects or induces a small amount of air from the train pipe to the piston via the bottom of the two valves and when the piston travels in the opposite direction it ejects to the atmosphere, via the top valve, that amount of air that it induced from the train pipe on its previous stroke. Should any irregularity occur with the pump, close cock on the train pipe side of pump and carry on with the ejector on footplate in ordinary way (Fig. 11)

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#### A further exposition on the Injector.

Turn on feed water - this floods the injector, turn on boiler steam, steam passes through the top cone (steam cone see Fig. 8 (A), the steam and water come into contact just above the lifting cone (B) and it is here that the vacuum is created. Air at atmospheric pressure now rushes up the overflow pipe to destroy the vacuum thus formed, in doing so, it carries with it the combining cone (C) which lifts to the lifting cone making a clean passage through the delivery cone, (D) delivery pipe and boiler. N.B. It will readily be seen that if the injector has any leaky joints, a poor vacuum is formed, with a consequent partial lifting of the combining cone and wastage of water at the overflow.

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#### MENSURATION.

22 yards	=	1 chain	220 yards	=	1 furlong
80 chains	=	1 mile	8 furlongs	=	1 mile
1760 yards	=	1 mile	3 miles	=	1 league

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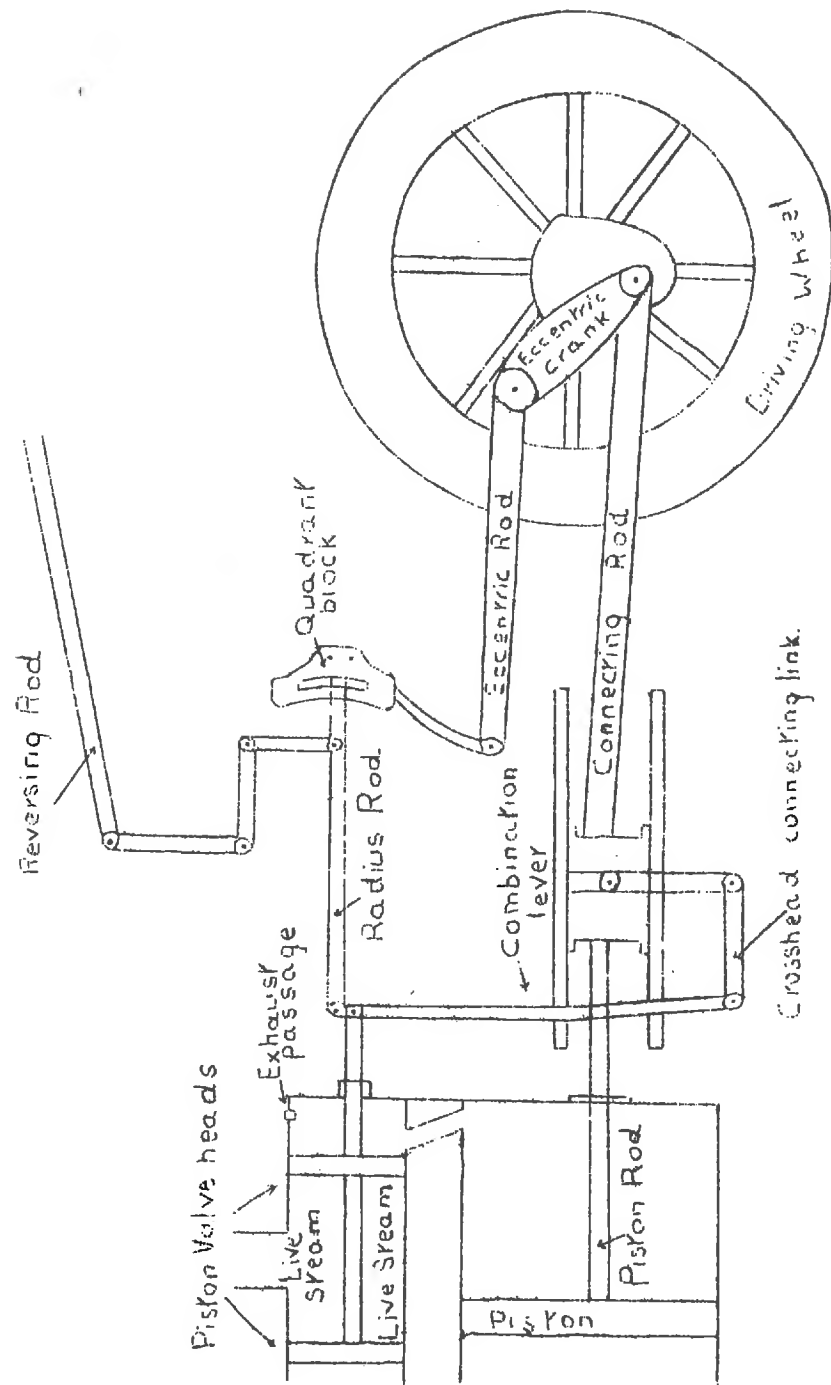


FIG. 9.

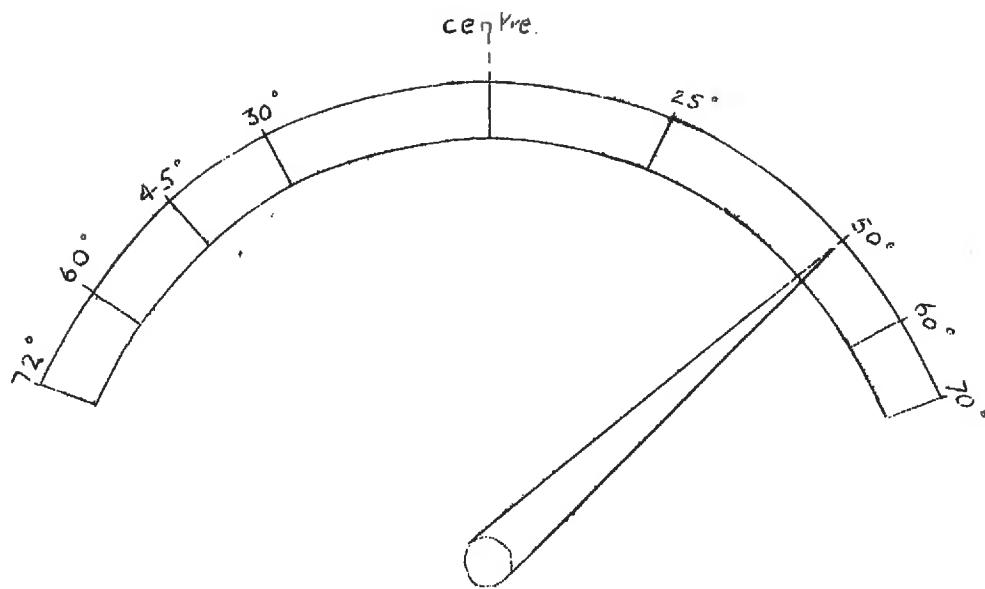
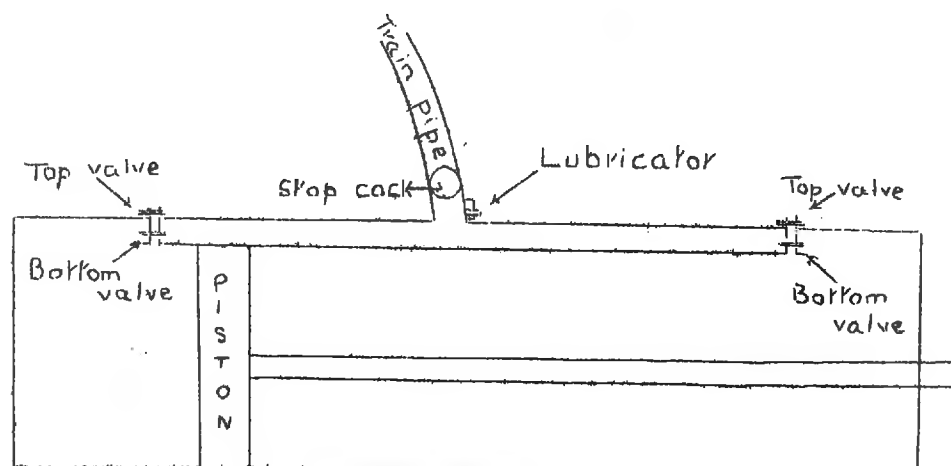


FIG 10



On some class of engines, the stop cock is just above the motion bar.

FIG 11